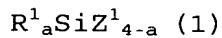


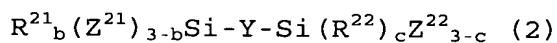
CLAIMS

1. A porous film-forming composition comprising (A) and (B):

(A) 100 parts by weight of at least one hydrolyzable silicon compound and/or at least one product resulting from at least partial hydrolysis condensation of the silicon compound selected from the group consisting of compounds expressed by following formulae (1) and (2):



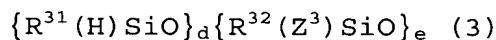
wherein  $Z^1$  denotes independently a hydrolyzable group, and when the compound (1) includes plurality of  $Z^1$ 's, the  $Z^1$ 's may be identical or different;  $R^1$  denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (1) includes plurality of  $R^1$ 's, the  $R^1$ 's may be identical or different; and  $a$  is an integer of 0 to 3; and



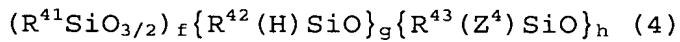
wherein  $Z^{21}$  and  $Z^{22}$  each denotes independently a hydrolyzable group, and when the compound (2) includes plurality of  $Z^{21}$ 's and/or  $Z^{22}$ 's, the  $Z^{21}$ 's and/or  $Z^{22}$ 's may be identical or different;  $R^{21}$  and  $R^{22}$  each denotes independently a substituted or non-substituted monovalent

hydrocarbon group, and when the compound (2) includes plurality of R<sup>21</sup>s and/or R<sup>22</sup>s, the R<sup>21</sup>s and/or R<sup>22</sup>s may be identical or different ; each of b and c denotes independently an integer of 0 to 2; and Y is an oxygen atom, a phenylene group, or a divalent hydrocarbon group; and

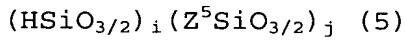
(B) 0.1 to 20 parts by weight of a cross-linking agent comprising at least one cyclic or multiple-branched oligomer which can generate one or more silanol groups by heating and which is selected from the group consisting of oligomers expressed by following formulae (3) to (8), wherein the oligomers:



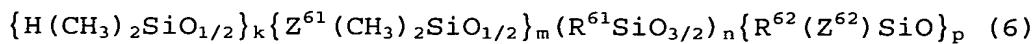
wherein R<sup>31</sup> and R<sup>32</sup> each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (3) includes plurality of R<sup>31</sup>s and/or R<sup>32</sup>s, the R<sup>31</sup>s and/or R<sup>32</sup>s may be identical or different; Z<sup>3</sup> denotes independently a group which can generate silanol by heating, and when the compound (3) includes plurality of Z<sup>3</sup>s, the Z<sup>3</sup>s may be identical or different; and each d and e denotes independently an integer of 0 to 10, and a sum of d and e is greater than or equal to three;



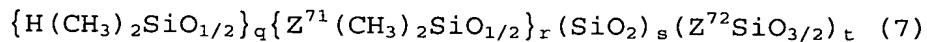
wherein  $R^{41}$ ,  $R^{42}$  and  $R^{43}$  each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (4) includes plurality of  $R^{41}$ s,  $R^{42}$ s and/or  $R^{43}$ s, the  $R^{41}$ s,  $R^{42}$ s and/or  $R^{43}$ s may be identical or different;  $Z^4$  denotes independently a group which can generate silanol by heating, and when the compound (4) includes plurality of  $Z^4$ s, the  $Z^4$ s may be identical or different; and each  $f$ ,  $g$  and  $h$  denotes independently an integer from 0 to 10, a sum of  $f$ ,  $g$  and  $h$  is greater than or equal to four, and  $f$  is an even number;



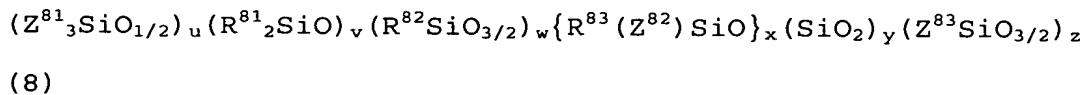
wherein  $Z^5$  denotes independently a group which can generate silanol by heating, and when the compound (5) includes plurality of  $Z^5$ s, the  $Z^5$ s may be identical or different; and each  $i$  and  $j$  denotes independently an integer from 0 to 10, a sum of  $i$  and  $j$  is greater than or equal to four, and a sum of  $i$  and  $j$  is an even number;



wherein R<sup>61</sup> and R<sup>62</sup> each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (6) includes plurality of R<sup>61</sup>'s and/or R<sup>62</sup>'s, the R<sup>61</sup>'s and/or R<sup>62</sup>'s may be identical or different; Z<sup>61</sup> and Z<sup>62</sup> each denotes independently a group which can generate silanol by heating, and when the compound (6) includes plurality of Z<sup>61</sup>'s and/or Z<sup>62</sup>'s, the Z<sup>61</sup>'s and/or Z<sup>62</sup>'s may be identical or different; and each k, m, n and p denotes independently an integer from 0 to 20, a sum of k, m, n and p is greater than or equal to five, and a sum of k, m and n is an even number;



wherein Z<sup>71</sup> and Z<sup>72</sup> each denotes independently a group which can generate silanol by heating, and when the compound (7) includes plurality of Z<sup>71</sup>'s and/or Z<sup>72</sup>'s, the Z<sup>71</sup>'s and/or Z<sup>72</sup>'s may be identical or different; and each q, r, s and t denotes independently an integer from 0 to 20, a sum of q, r, s and t is greater than or equal to four, and a sum of q, r and t is an even numbers; and



wherein R<sup>81</sup>, R<sup>82</sup> and R<sup>83</sup> each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (8) includes plurality of R<sup>81</sup>s, R<sup>82</sup>s and/or R<sup>83</sup>s, the R<sup>81</sup>s, R<sup>82</sup>s and/or R<sup>83</sup>s may be identical or different; each Z<sup>81</sup>, Z<sup>82</sup> and Z<sup>83</sup> denotes independently a group which can generate silanol by heating, and when the compound (8) includes plurality of Z<sup>81</sup>s, Z<sup>82</sup>s and/or Z<sup>83</sup>s, the Z<sup>81</sup>s, Z<sup>82</sup>s and/or Z<sup>83</sup>s may be identical or different; and each u, v, w, x, y and z denotes independently an integer from 0 to 20, a sum of u, v, w, x, y and z is greater than or equal to three, and a sum of u, w and z is an even number.

2. The porous film-forming composition according to claim 1, further comprising organic solvent.
3. The film-forming composition according to claim 1, wherein said oligomer has a group which can generate said one or more silanol groups by heating and which has a decomposition temperature of 350°C or less.
4. The film-forming composition according to claim 1, wherein said oligomer has a group which can generate one or more silanol groups by heating and which is a secondary alkoxy group or a tertiary alkoxy group.

5. A method for forming a porous film, comprising the steps of:

applying the composition according to any one of claims 1 to 4 to a substrate to form a film thereon;

applying a 1<sup>st</sup> thermal processing to the film at temperature adequate to volatilize the solvent in the film; and

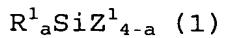
subsequently applying a 2<sup>nd</sup> thermal processing to the film.

6. A porous film obtainable by using the porous film-forming composition according to any one of claims 1 to 3.

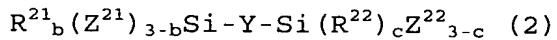
7. An interlevel insulating film obtainable by using the porous film-forming composition according to any one of claims 1 to 3.

8. A semiconductor device comprising an internal porous film obtainable by using a porous film-forming composition comprising (A) and (B):

(A) 100 parts by weight of at least one hydrolyzable silicon compound and/or at least one product resulting from at least partial hydrolysis condensation of the silicon compound selected from the group consisting of compounds expressed by following formulae (1) and (2):

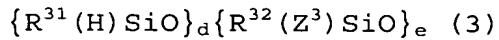


wherein  $Z^1$  denotes independently a hydrolyzable group, and when the compound (1) includes plurality of  $Z^1$ 's, the  $Z^1$ 's may be identical or different;  $R^1$  denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (1) includes plurality of  $R^1$ 's, the  $R^1$ 's may be identical or different; and  $a$  is an integer of 0 to 3; and

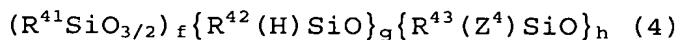


wherein  $Z^{21}$  and  $Z^{22}$  each denotes independently a hydrolyzable group, and when the compound (2) includes plurality of  $Z^{21}$ 's and/or  $Z^{22}$ 's, the  $Z^{21}$ 's and/or  $Z^{22}$ 's may be identical or different;  $R^{21}$  and  $R^{22}$  each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (2) includes plurality of  $R^{21}$ 's and/or  $R^{22}$ 's, the  $R^{21}$ 's and/or  $R^{22}$ 's may be identical or different; each of  $b$  and  $c$  denotes independently an integer of 0 to 2; and  $Y$  is an oxygen atom, a phenylene group, or a divalent hydrocarbon group; and

(B) 0.1 to 20 parts by weight of a cross-linking agent comprising at least one cyclic or multiple-branched oligomer which can generate one or more silanol groups by heating and which is selected from the group consisting of oligomers expressed by following formulae (3) to (8), wherein the oligomers:

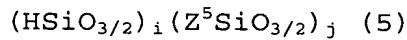


wherein  $R^{31}$  and  $R^{32}$  each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (3) includes plurality of  $R^{31}$ 's and/or  $R^{32}$ 's, the  $R^{31}$ 's and/or  $R^{32}$ 's may be identical or different;  $Z^3$  denotes independently a group which can generate silanol by heating, and when the compound (3) includes plurality of  $Z^3$ 's, the  $Z^3$ 's may be identical or different; and each  $d$  and  $e$  denotes independently an integer of 0 to 10, and a sum of  $d$  and  $e$  is greater than or equal to three;

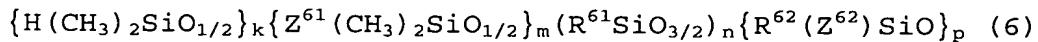


wherein  $R^{41}$ ,  $R^{42}$  and  $R^{43}$  each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (4) includes plurality of  $R^{41}$ 's,  $R^{42}$ 's and/or  $R^{43}$ 's, the  $R^{41}$ 's,  $R^{42}$ 's and/or  $R^{43}$ 's may be identical

or different;  $Z^4$  denotes independently a group which can generate silanol by heating, and when the compound (4) includes plurality of  $Z^4$ 's, the  $Z^4$ 's may be identical or different; and each f, g and h denotes independently an integer from 0 to 10, a sum of f, g and b is greater than or equal to four, and f is an even number;

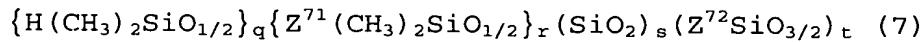


wherein  $Z^5$  denotes independently a group which can generate silanol by heating, and when the compound (5) includes plurality of  $Z^5$ 's, the  $Z^5$ 's may be identical or different; and each i and j denotes independently an integer from 0 to 10, a sum of i and j is greater than or equal to four, and a sum of i and j is an even number;

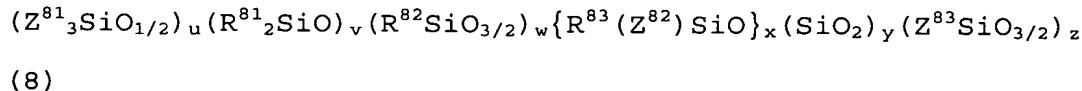


wherein  $R^{61}$  and  $R^{62}$  each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (6) includes plurality of  $R^{61}$ 's and/or  $R^{62}$ 's, the  $R^{61}$ 's and/or  $R^{62}$ 's may be identical or different;  $Z^{61}$  and  $Z^{62}$  each denotes independently a group which can generate silanol by heating, and when the compound (6) includes plurality of  $Z^{61}$ 's and/or  $Z^{62}$ 's, the  $Z^{61}$ 's and/or  $Z^{62}$ 's may be

identical or different; and each k, m, n and p denotes independently an integer from 0 to 20, a sum of k, m, n and p is greater than or equal to five, and a sum of k, m and n is an even number;



wherein Z<sup>71</sup> and Z<sup>72</sup> each denotes independently a group which can generate silanol by heating, and when the compound (7) includes plurality of Z<sup>71</sup>s and/or Z<sup>72</sup>s, the Z<sup>71</sup>s and/or Z<sup>72</sup>s may be identical or different; and each q, r, s and t denotes independently an integer from 0 to 20, a sum of q, r, s and t is greater than or equal to four, and a sum of q, r and t is an even numbers; and



wherein R<sup>81</sup>, R<sup>82</sup> and R<sup>83</sup> each denotes independently a substituted or non-substituted monovalent hydrocarbon group, and when the compound (8) includes plurality of R<sup>81</sup>s, R<sup>82</sup>s and/or R<sup>83</sup>s, the R<sup>81</sup>s, R<sup>82</sup>s and/or R<sup>83</sup>s may be identical or different; each Z<sup>81</sup>, Z<sup>82</sup> and Z<sup>83</sup> denotes independently a group which can generate silanol by heating, and when the compound (8) includes plurality of Z<sup>81</sup>s, Z<sup>82</sup>s and/or Z<sup>83</sup>s,

the Z<sup>81</sup>s, Z<sup>82</sup>s and/or Z<sup>83</sup>s may be identical or different; and each u, v, w, x, y and z denotes independently an integer from 0 to 20, a sum of u, v, w, x, y and z is greater than or equal to three, and a sum of u, w and z is an even number.

9. The semiconductor device according to claim 8, wherein the porous film-forming composition further comprises organic solvent.
10. The semiconductor device according to claim 8, wherein said oligomer has a group which can generate said one or more silanol groups by heating and which has a decomposition temperature of 350°C or less.
11. The semiconductor device according to claim 8, wherein said oligomer has a group which can generate one or more silanol groups by heating and which is a secondary alkoxy group or a tertiary alkoxy group.
12. The semiconductor device according to any one of claims 8 to 11, wherein said porous film is between metal interconnections in a same layer of multi-level interconnects, or is between vertical upper and lower metal interconnection layers.